

AEROKATS - Advancing Sensor Systems for Kites

Geoff Bland (NASA/GSFC/613)



“Aeropod”
Aerodynamically Stabilized
Instrument Platform*



*US Patent # 8,196,853

NASA's Science Activation (SciAct)

AEROKATS and ROVER Education Network **(AREN/Ogiemwonyi/WayneRESA)**




<https://science.nasa.gov/sciact-team/resa/>

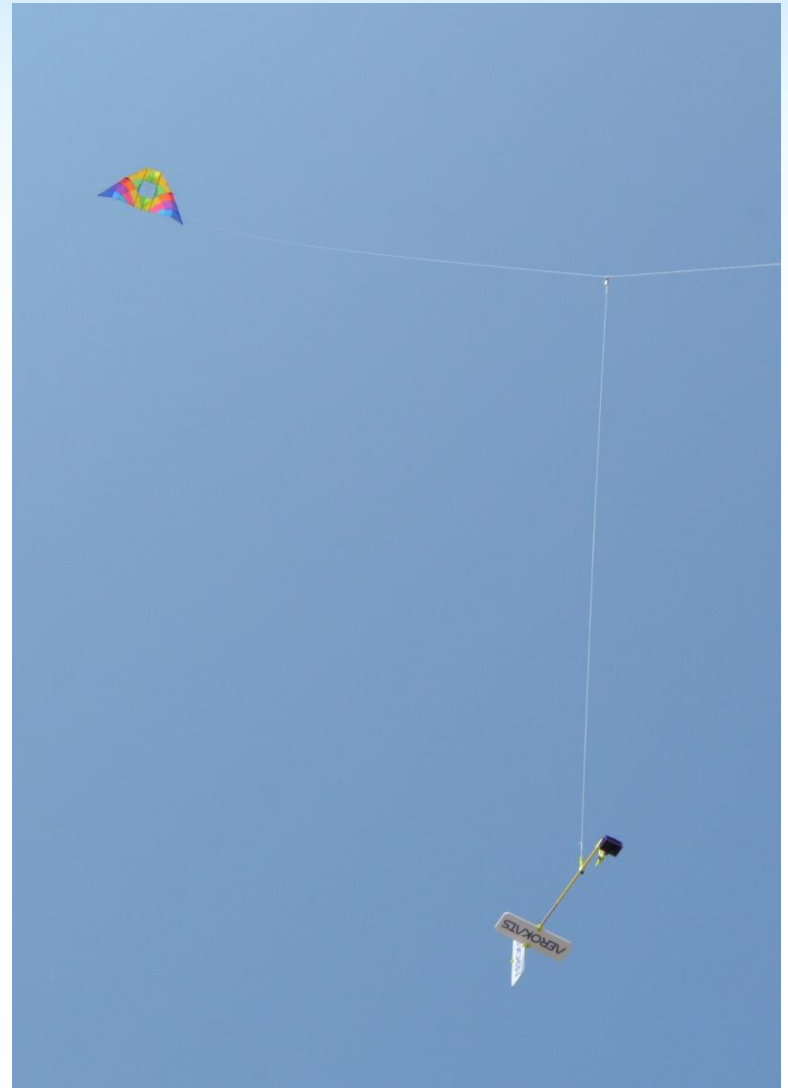
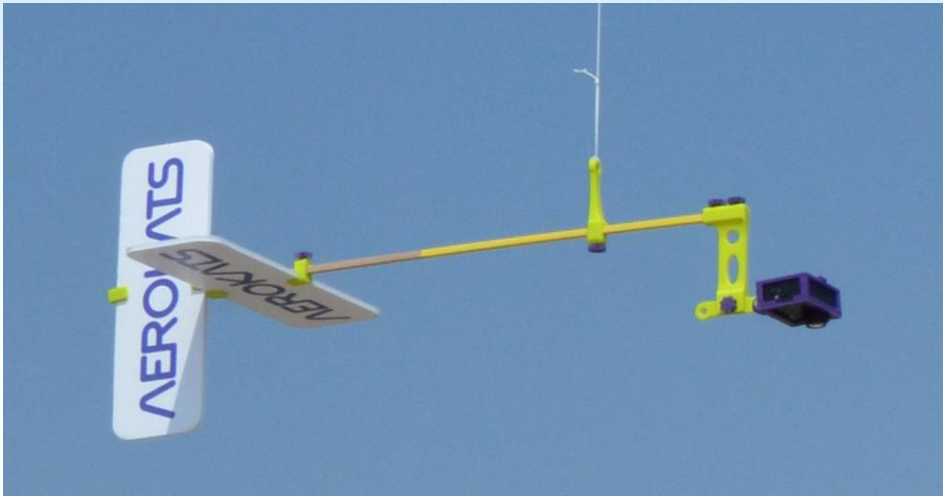
Instrumented *Aeropods* for Kites

- ***MonoCam*** (High Resolution Color Camera)
- ***MiniCam*** (Miniature Video Camera)
- ***ThermoCam*** (Thermal Infrared, Color Camera)
- ***Profiler*** (*Kestrel 5500*: 2D Winds, T, RH, P/Alt)
- ***PocketPod*** (*PocketLab Weather*: T, RH, P/Alt)
- ***AtmoPod*** (*AtmoTubePro*: PM 1/2.5/10, TVOC, T, RH, P/Alt)
- ***SwiftPod*** (*BST Swift Flow*: 3D Winds, T, RH, P/Alt, Lat/Long)
- ***TwinCam*** (Near Infrared, Color)

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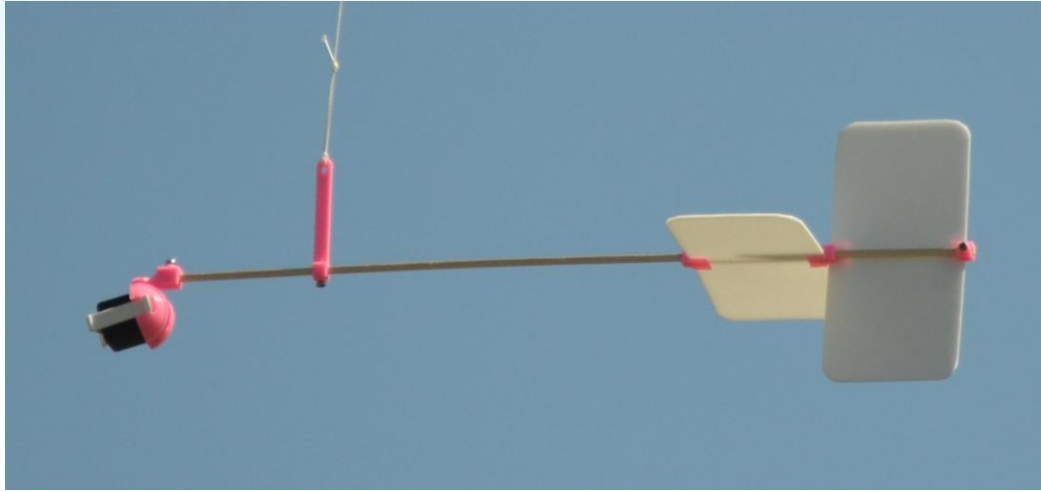
MonoCam (High Resolution Color Camera)



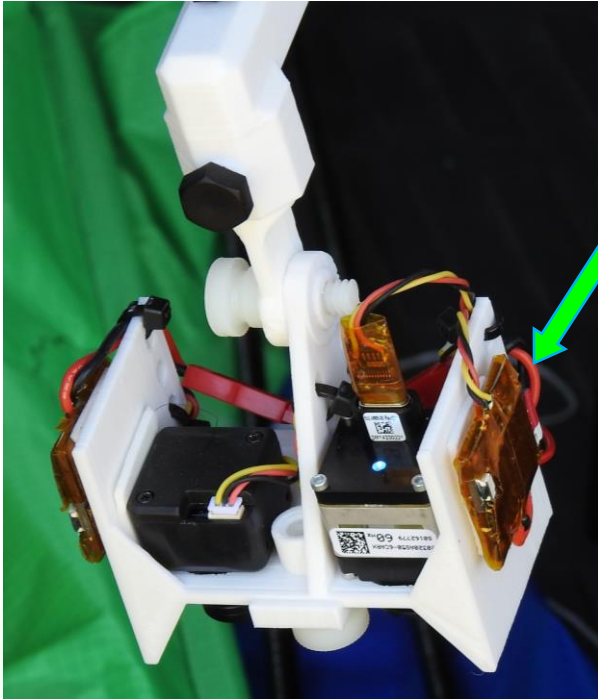
US Patent # 8,196,853
goeff.bland@nasa.gov



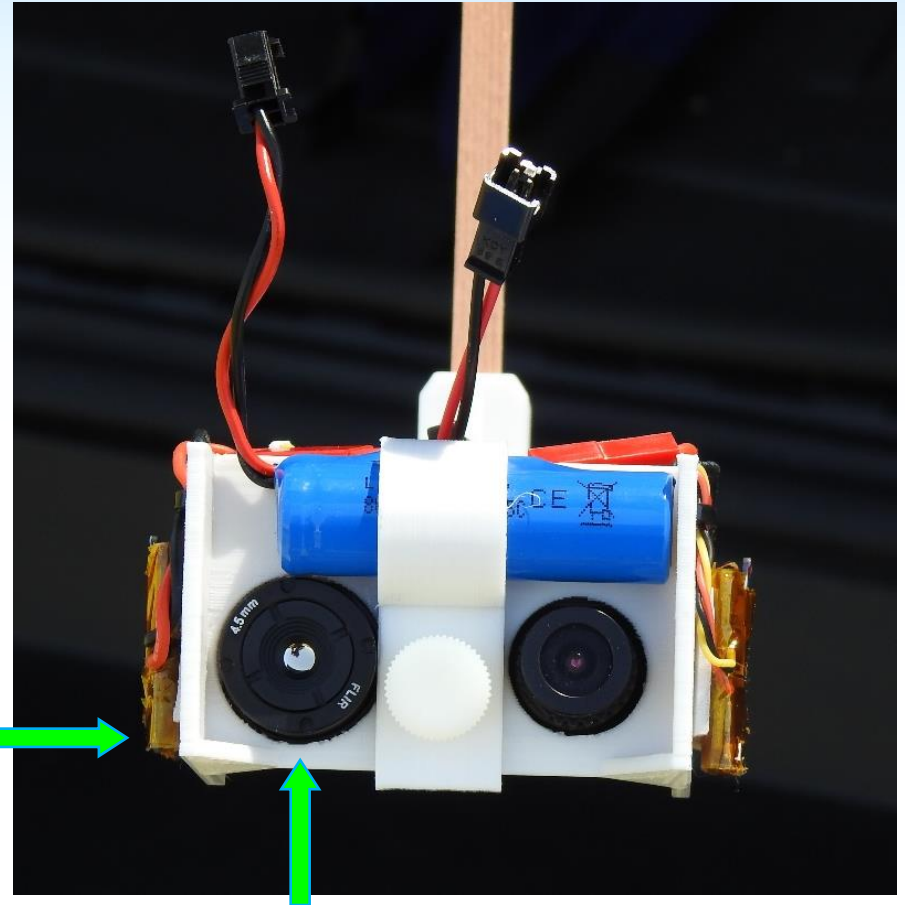
MiniCam (Miniature Video Camera)



ThermoCam (Thermal Infrared, Color Camera)



Solid State
Video
Recorders



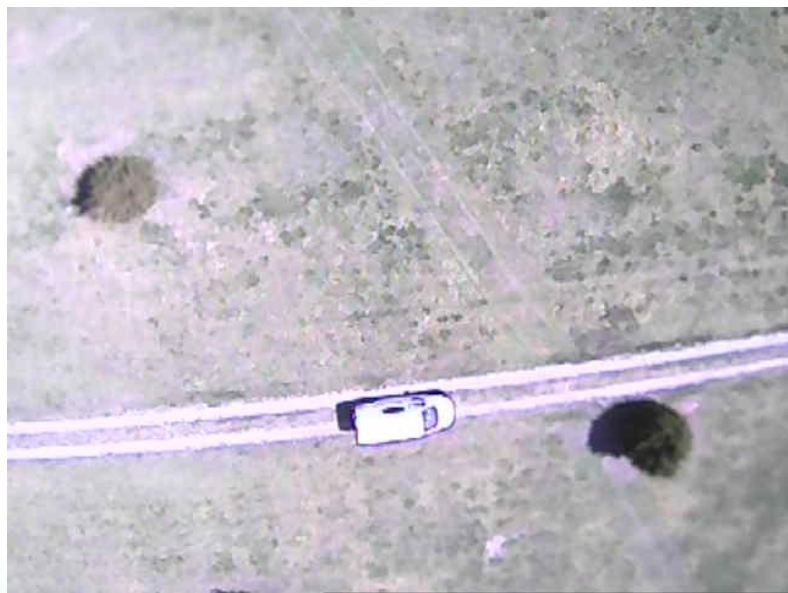
Teledyne FLIR BOSON 320 x 256
4.5mm Short Lens 50° HFoV

<https://www.oemcameras.com>

ThermoCam (Thermal Infrared, Color Camera)



Thermal
Images



Color
Images



Light Color Vehicle

Dark Color Vehicle

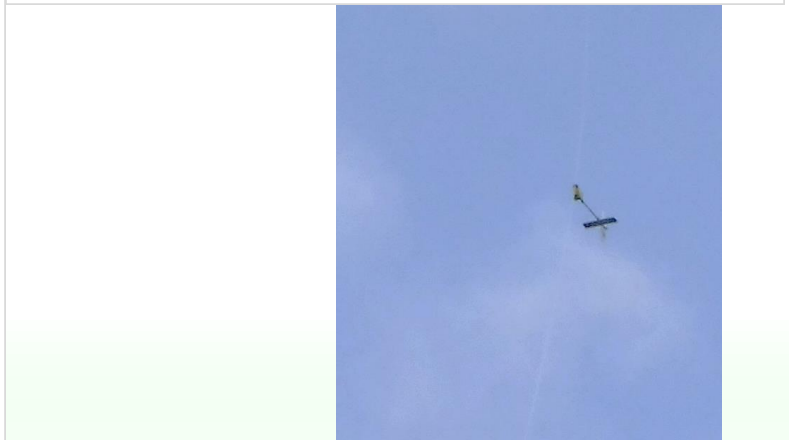
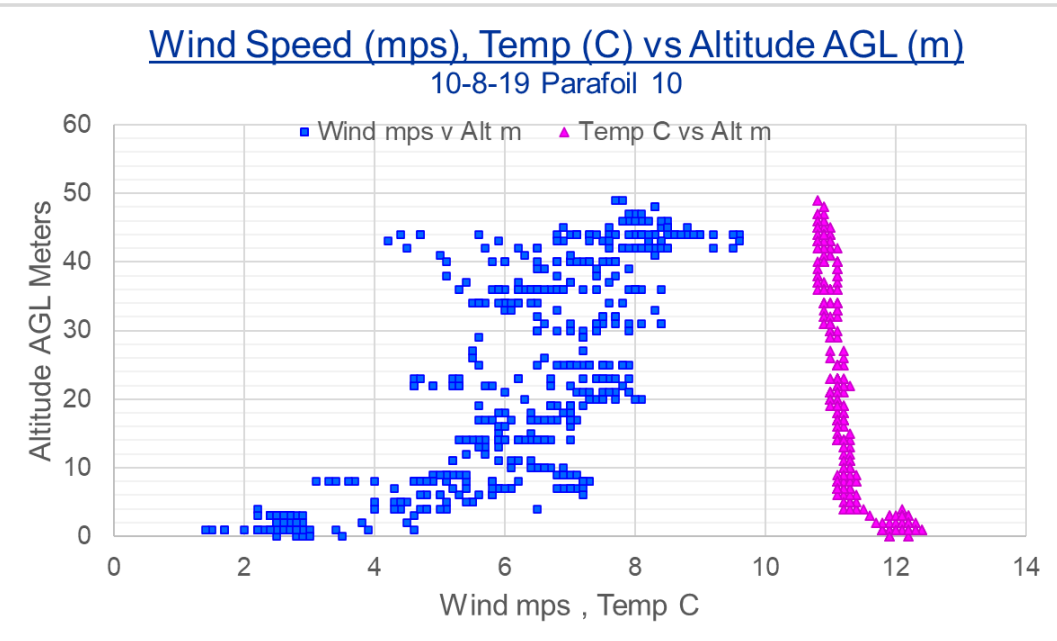
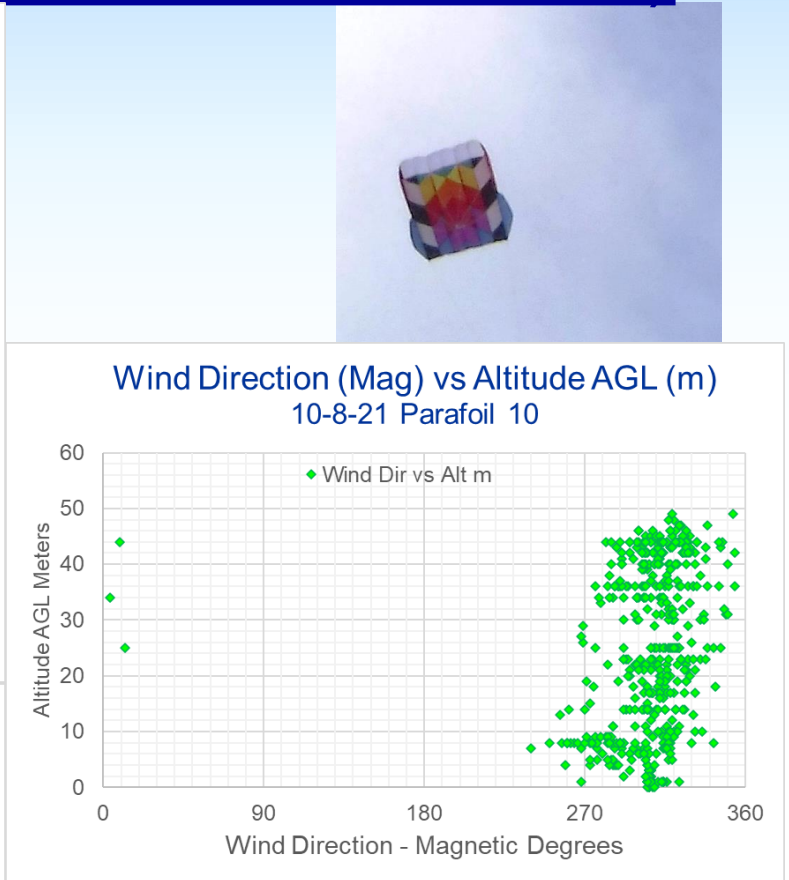
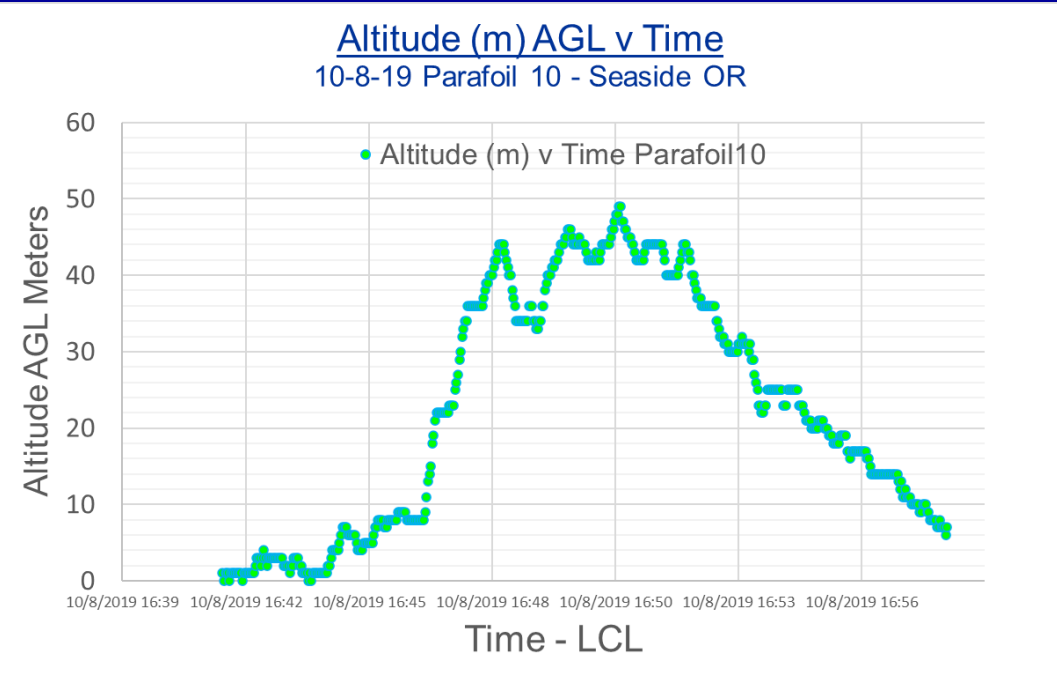
Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)



<https://kestrelmeters.com/products/kestrel-5500-weather-meter>

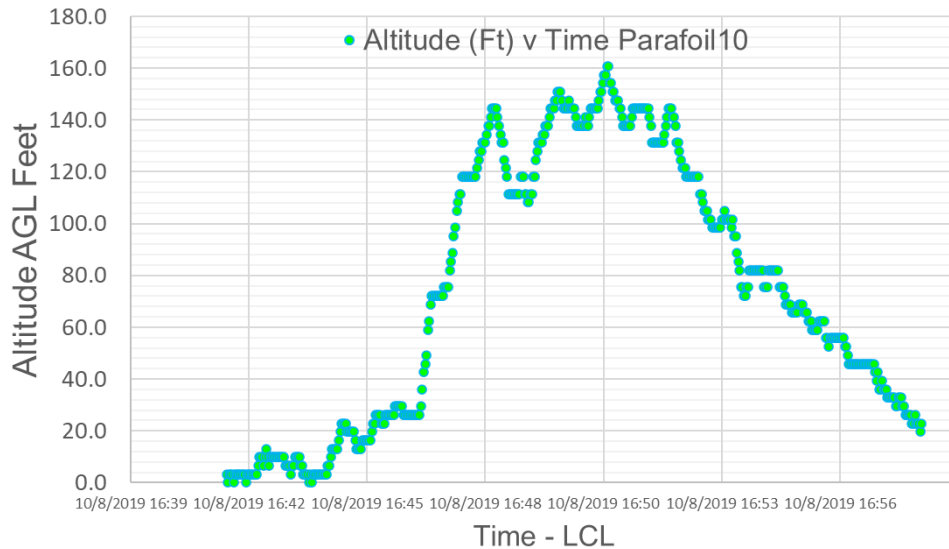
2 second data rate typical... > 10,000 data points
Temperature, Humidity, Pressure, Wind Speed, Wind Direction

Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)

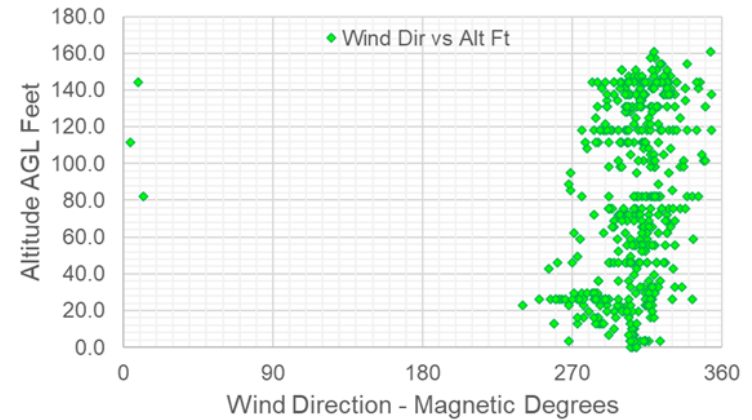


Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)

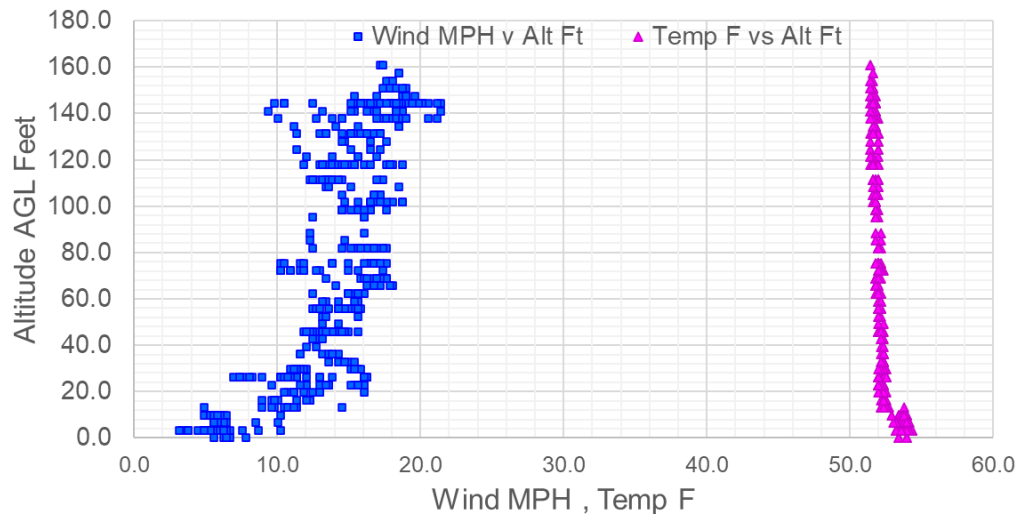
Altitude (Ft) AGL v Time
10-8-19 Parafoil 10 - Seaside OR



Wind Direction (Mag) vs Altitude AGL (Ft)
10-8-21 Parafoil 10

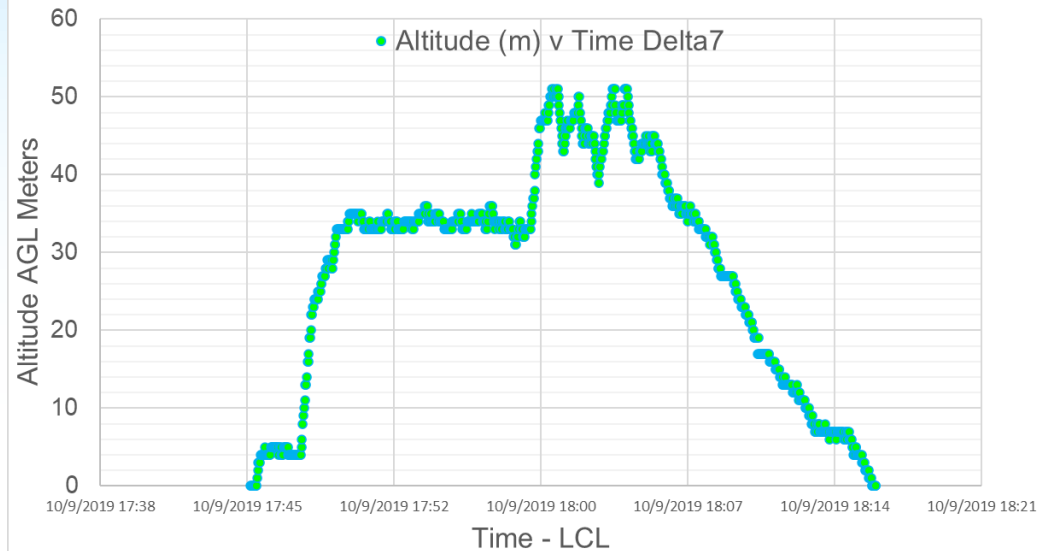


Wind Speed (MPH), Temp (F) vs Altitude AGL (Ft)
10-8-19 Parafoil 10

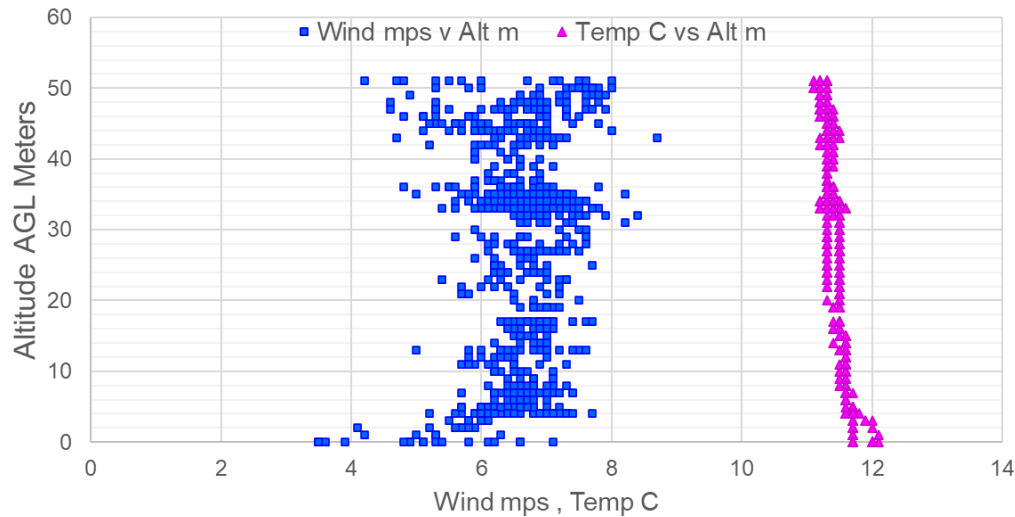


Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)

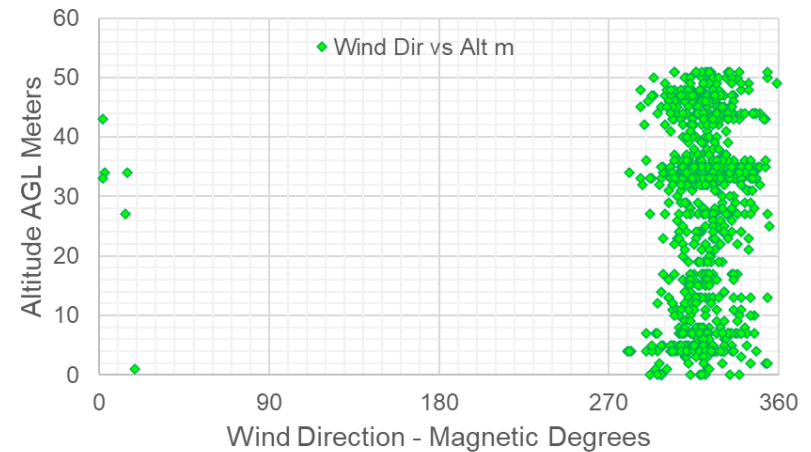
Altitude (m) AGL v Time
10-9-19 Delta 7 - Seaside OR



Wind Speed (mps), Temp (C) vs Altitude AGL (m)
10-9-19 Delta7

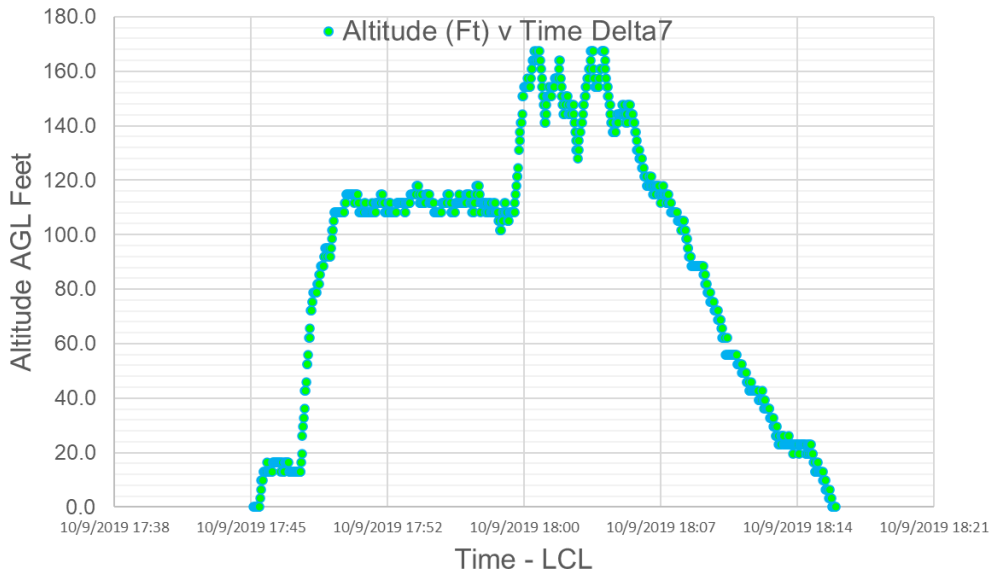


Wind Direction (Mag) vs Altitude AGL (m)
10-9-21 Delta 7

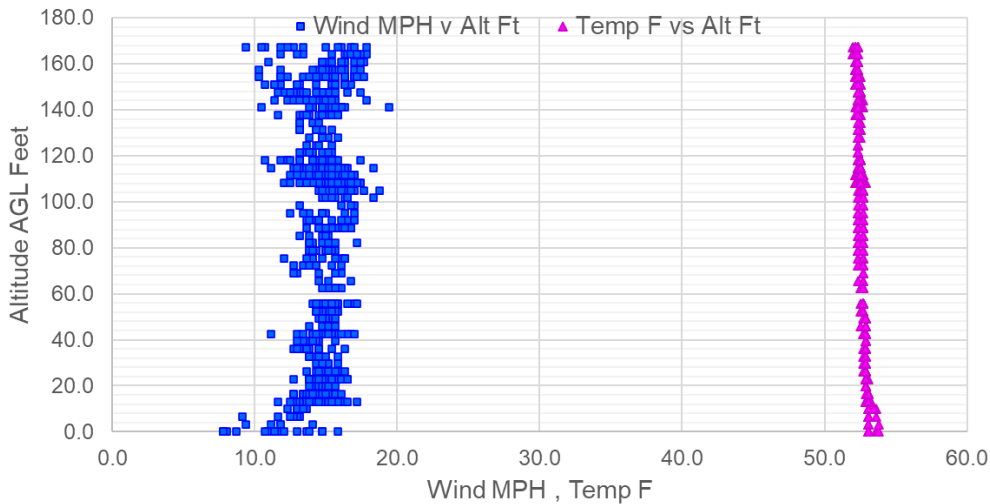


Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)

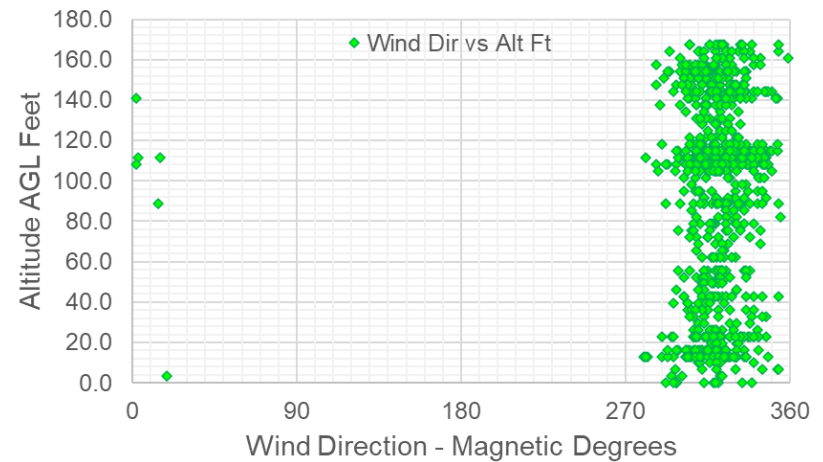
Altitude (Ft) AGL v Time
10-9-19 Delta 7 - Seaside OR



Wind Speed (MPH), Temp (F) vs Altitude AGL (Ft)
10-9-19 Delta7



Wind Direction (Mag) vs Altitude AGL (Ft)
10-9-21 Delta 7

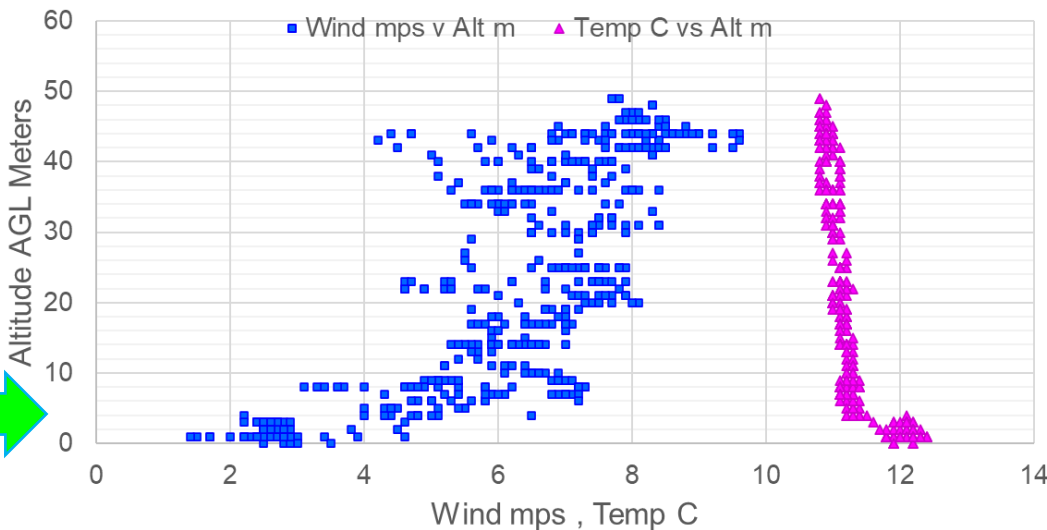


Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)



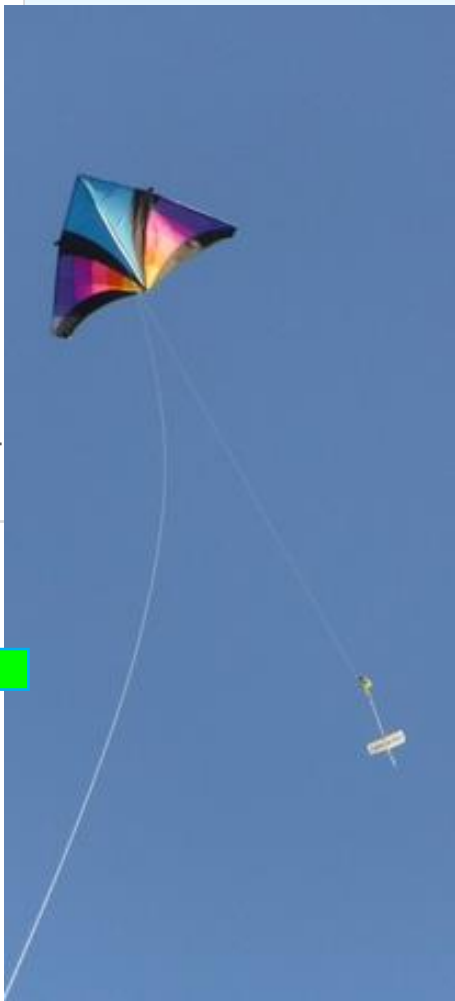
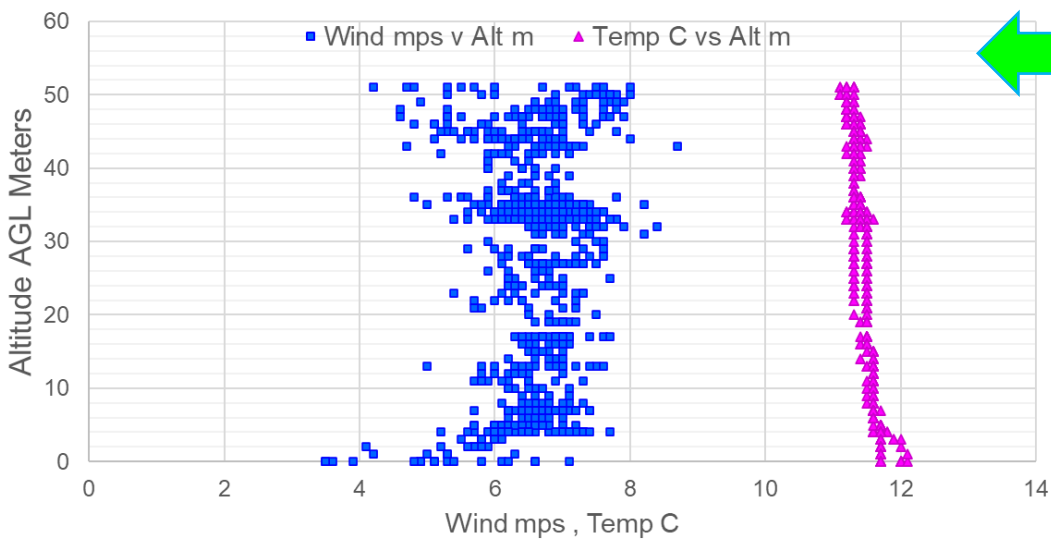
Wind Speed (mps), Temp (C) vs Altitude AGL (m)

10-8-19 Parafoil 10



Wind Speed (mps), Temp (C) vs Altitude AGL (m)

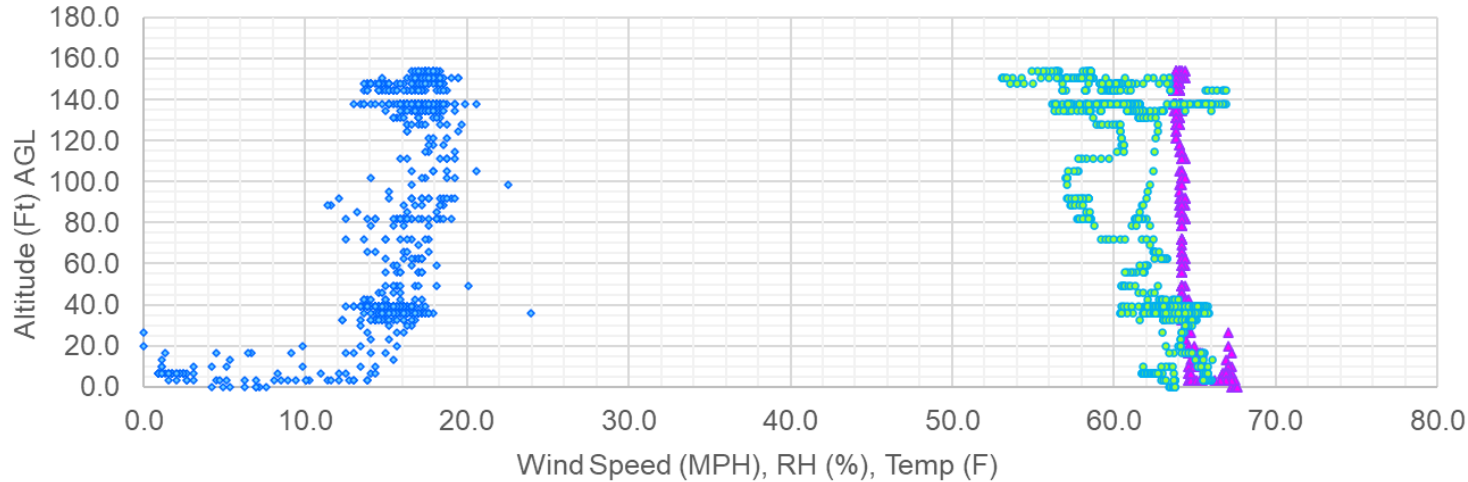
10-9-19 Delta7



Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)

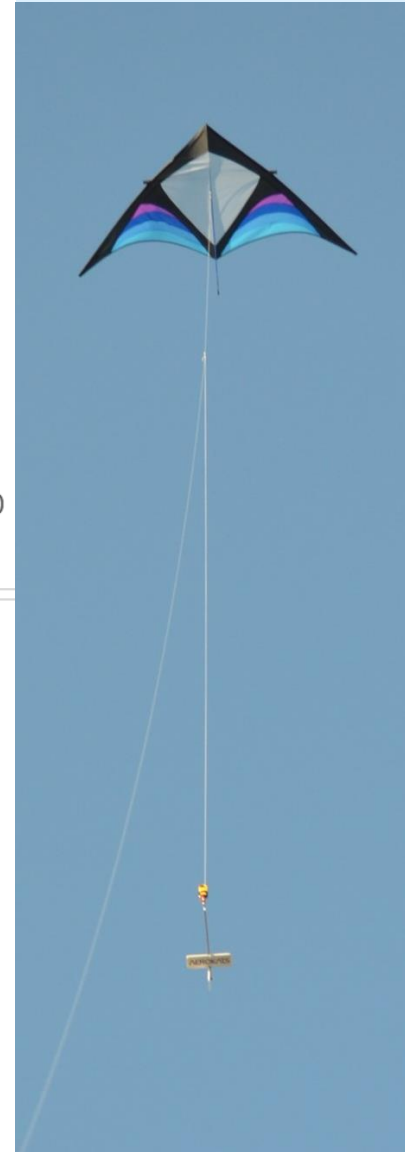
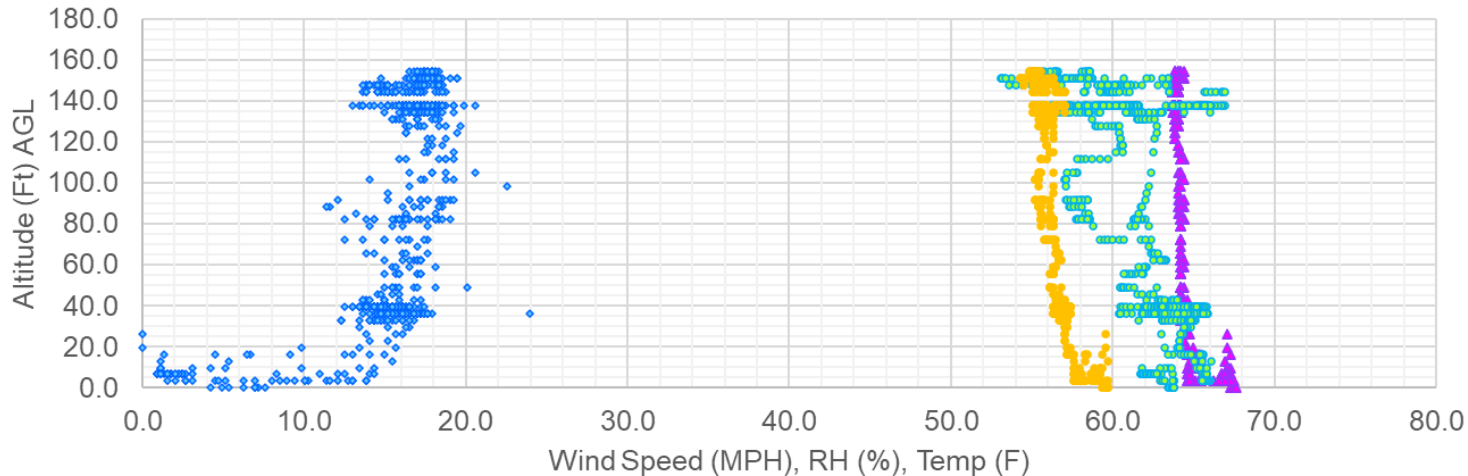
XFS Flt 1 10-11-22 Ocean City

◆ Wind MPH vs Alt Ft AGL ▲ Temp F vs Alt Ft AGL ● RH% vs Alt Ft AGL



XFS Flt 1 10-11-22 Ocean City

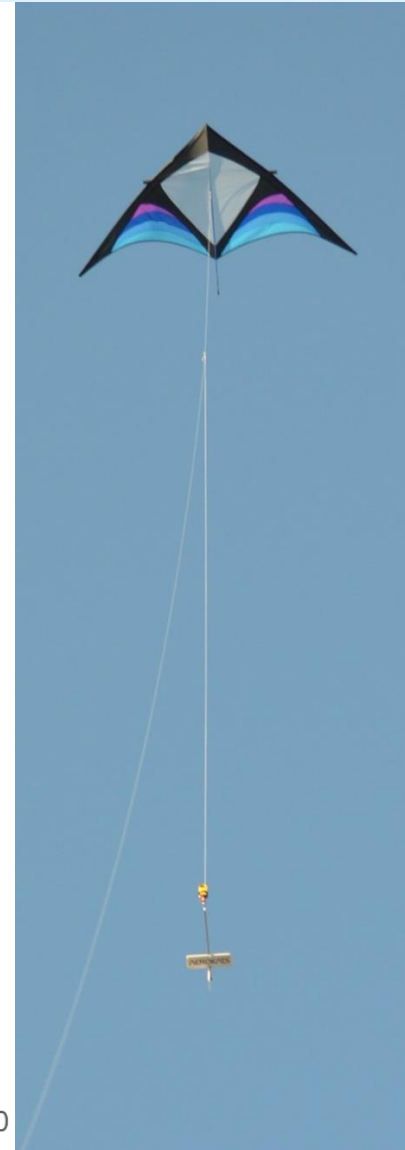
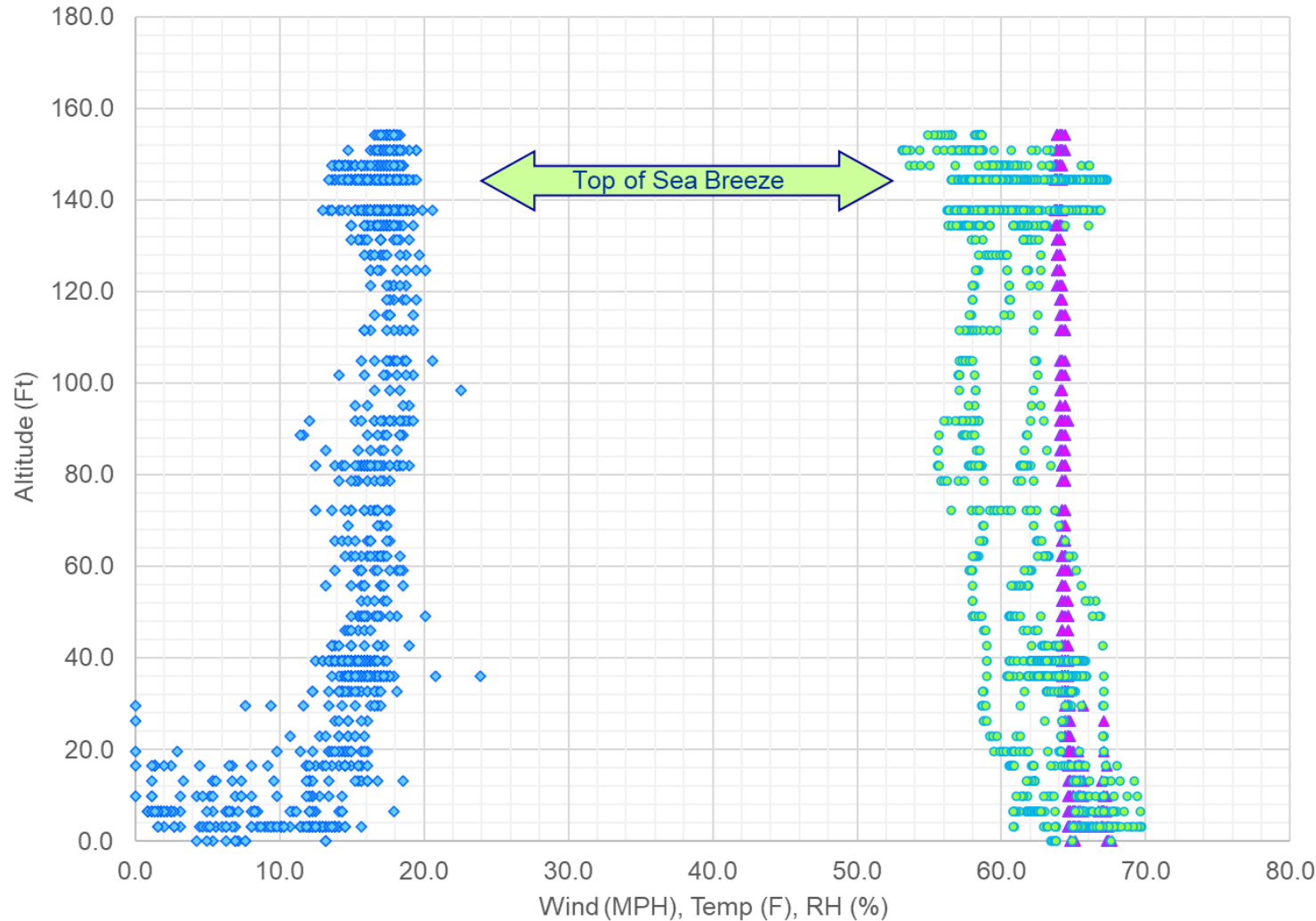
◆ Wind MPH vs Alt Ft AGL ▲ Temp F vs Alt Ft AGL ● RH% vs Alt Ft AGL ● Wet Bulb Temp F



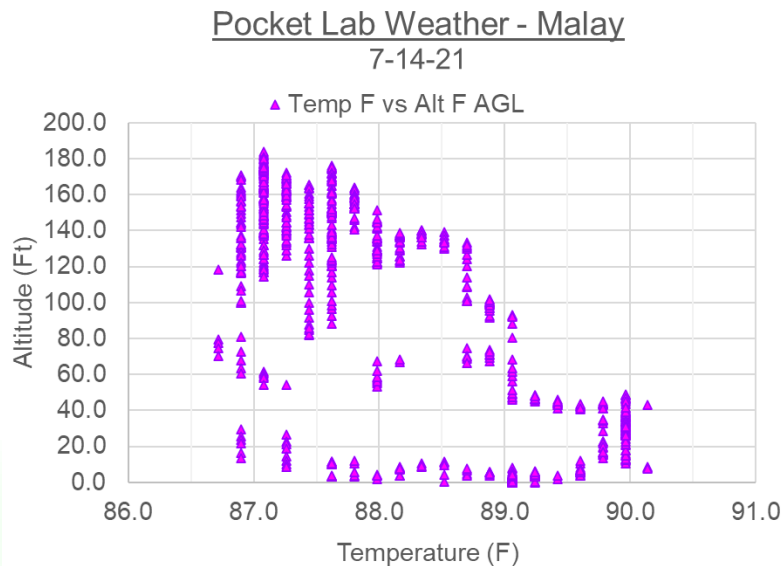
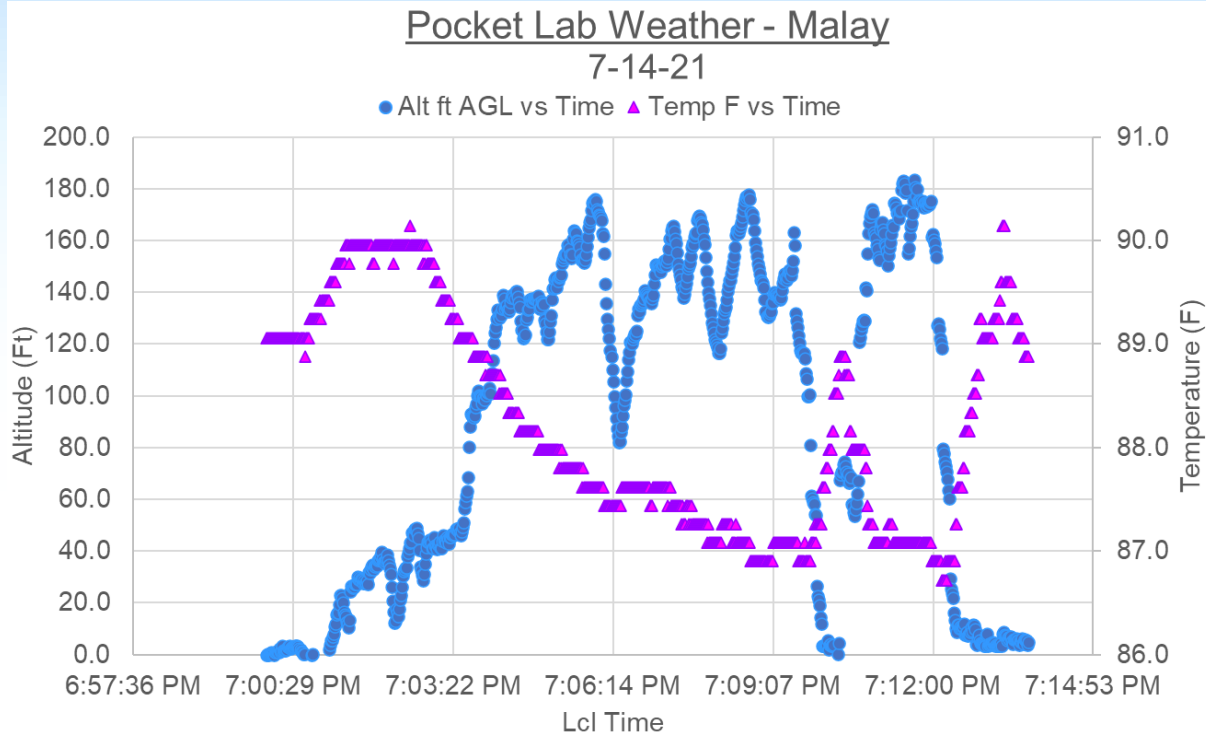
Profiler (Kestrel 5500: 2D Winds, T, RH, P/Alt)

DL XFS Flight 1 & 2 10-11-22 Ocean City

◆ Wind MPH vs Alt Ft AGL ▲ Temp F vs Alt Ft AGL ● RH% vs Alt Ft AGL



PocketPod (PocketLab Weather: T, RH, P/Alt)



<https://www.thepocketlab.com/store/pocketlab-weather>



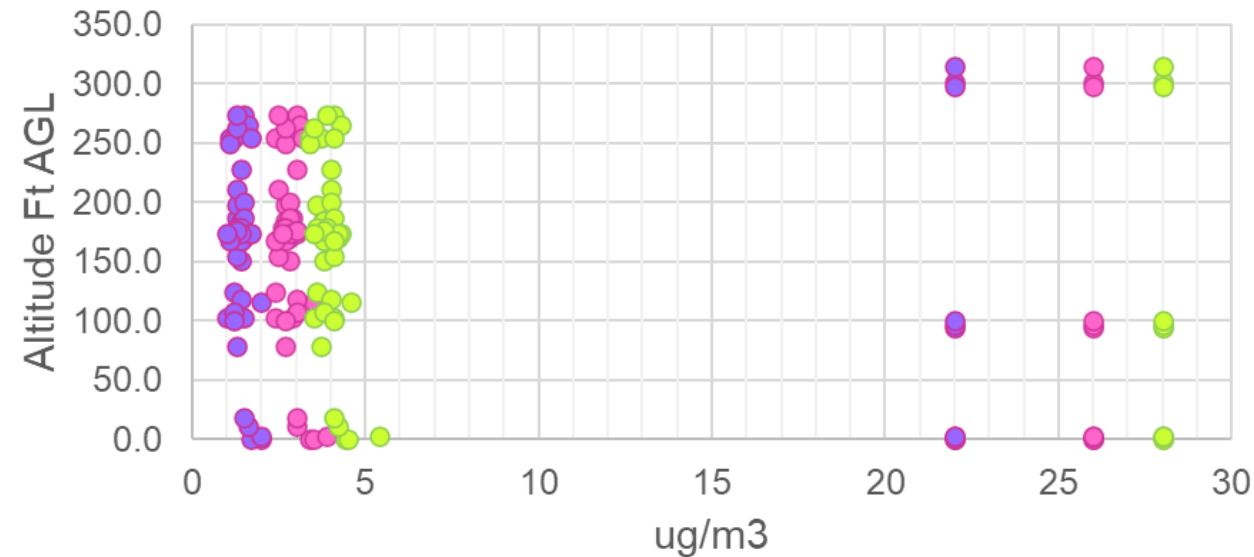
AtmoPod

(AtmoTubePro: PM 1/2.5/10, TVOC, T, RH, P/Alt)



AtmoTube Pro 9-1-23 Delta 7

● PM 1 vs Alt Ft AGL ● PM 2.5 vs Alt Ft AGL ● PM 10 v Alt Ft AGL

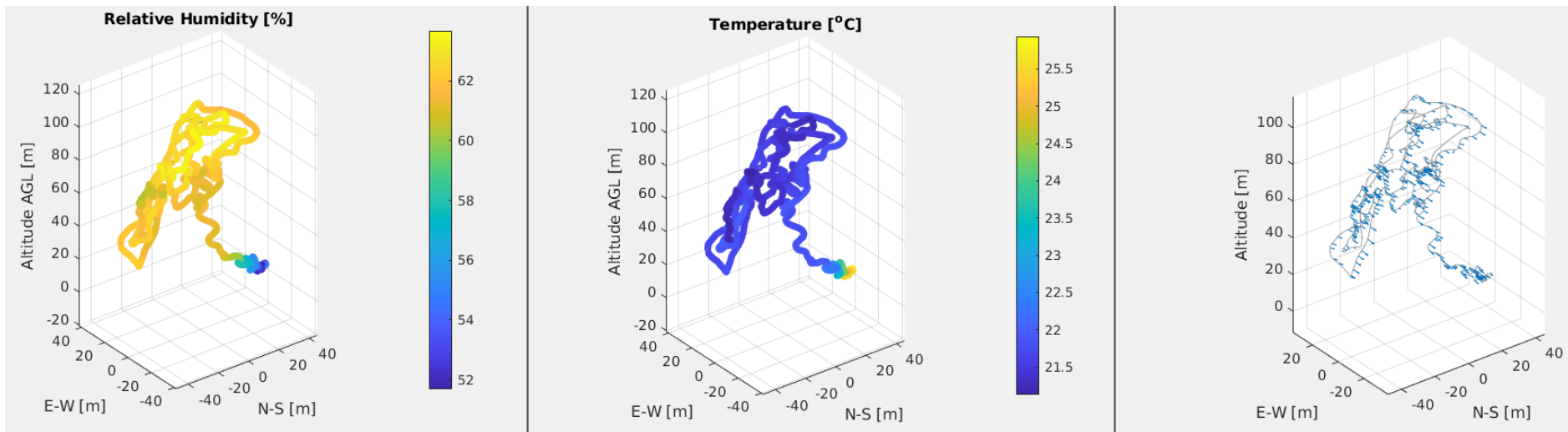
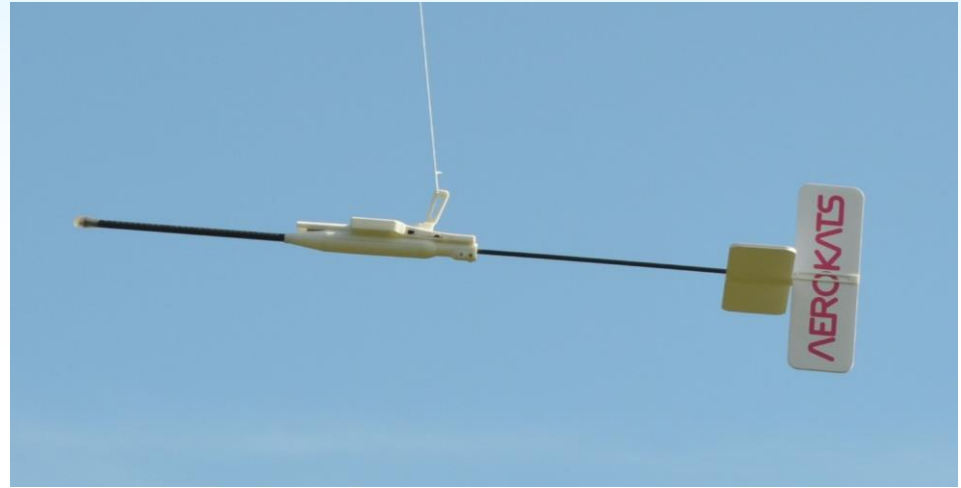
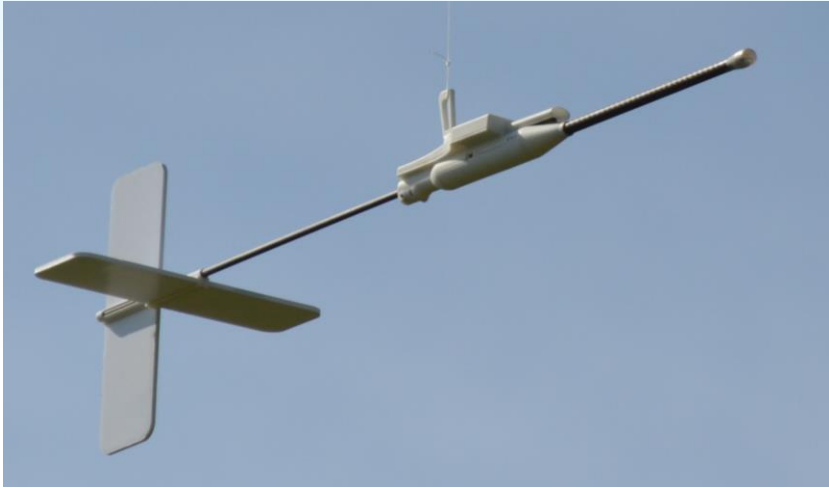


<https://atmotube.com/atmotube-pro>

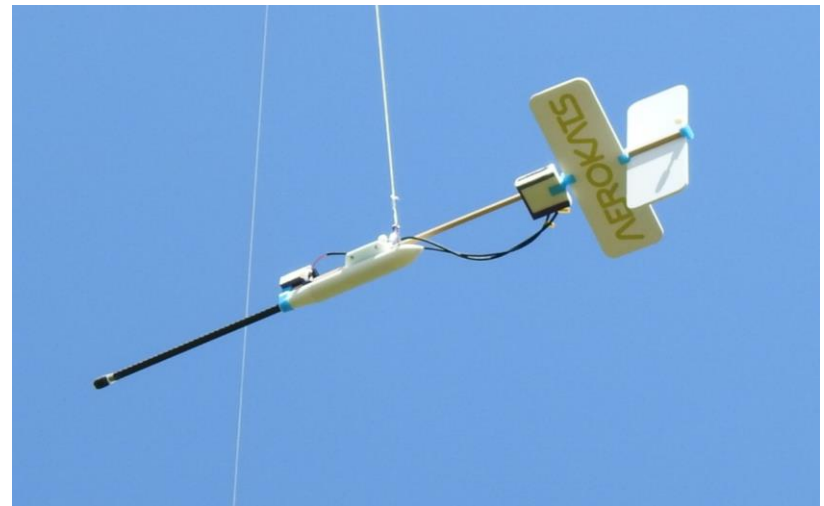
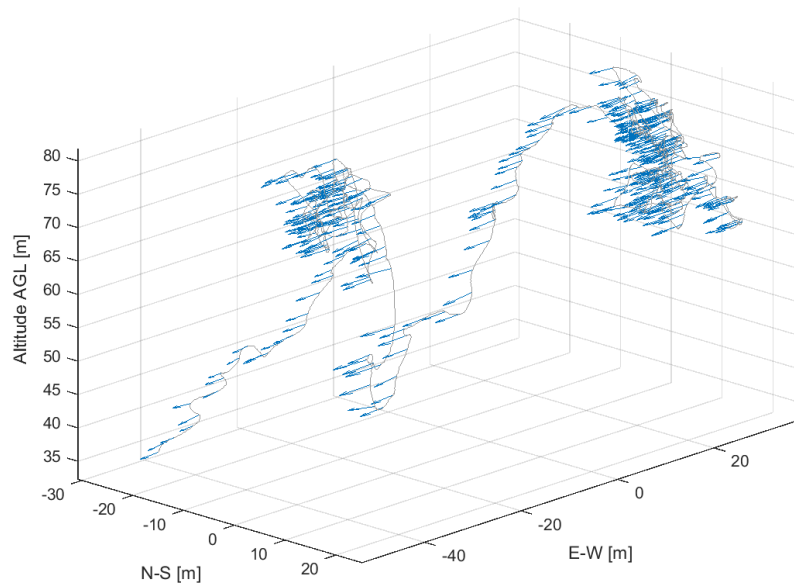
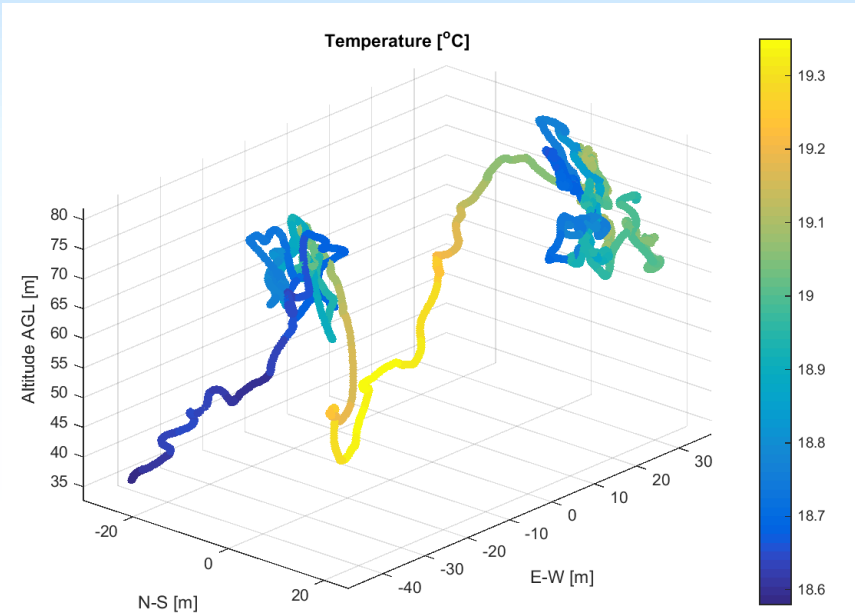
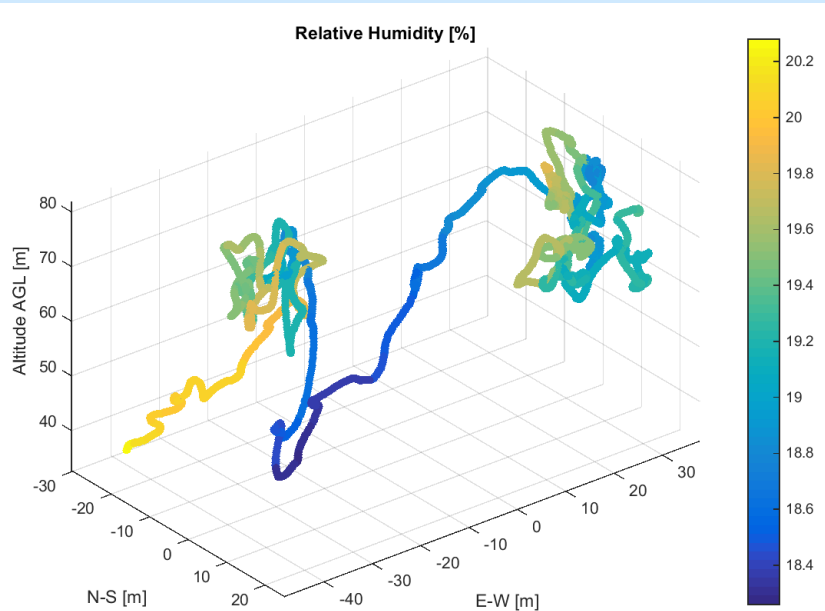
SwiftPod

(BST Swift Flow: 3D Winds, T, RH, P/Alt, Lat/Long)

adapted from multi-port *SwiftFlow* UAS instrument



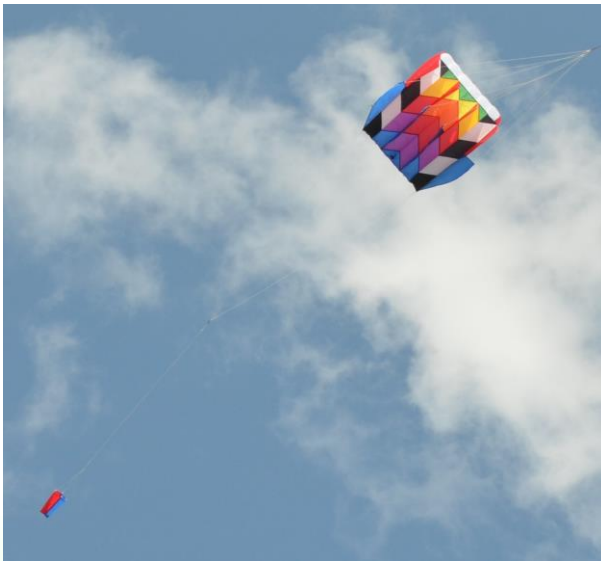
SwiftPod



	Measurement Parameters	Instrument Mass (g)	Total Aeropod Mass (g)	Easy to Fly?	Easy to Use?	Easy to Interpret Data?	Cost (\$)
<i>MonoCam</i>	Color Images (Still and Video)	70	165		√	√	100-150 \$
<i>MiniCam</i>	Color Video	18	35	★			20-30 \$
<i>ThermoCam</i>	Thermal and Color Video	99	194				2100 \$
<i>Profiler (Kestrel)</i>	Temp, RH, Wind Speed/Direction, Altitude	118	220		★		450 \$
<i>Pocket lab Weather</i>	Temp, RH, Altitude, Light	17	35	√		√	130 \$
<i>AtmoTube Pro</i>	PM 1, 2.5, 10, TVOC, Temp, RH, Altitude	104	190		★	★	150-200 \$
<i>SwiftFlow</i>	3D Winds, GPS Position, T, RH, Pressure	144	225		√	(√)	tbd

Kites

Stability is Important!



Delta (top), Parafoil (bottom)

Delta Conyne ("DC")

Diamond/Malay

Kites

Custom or Commercially Available

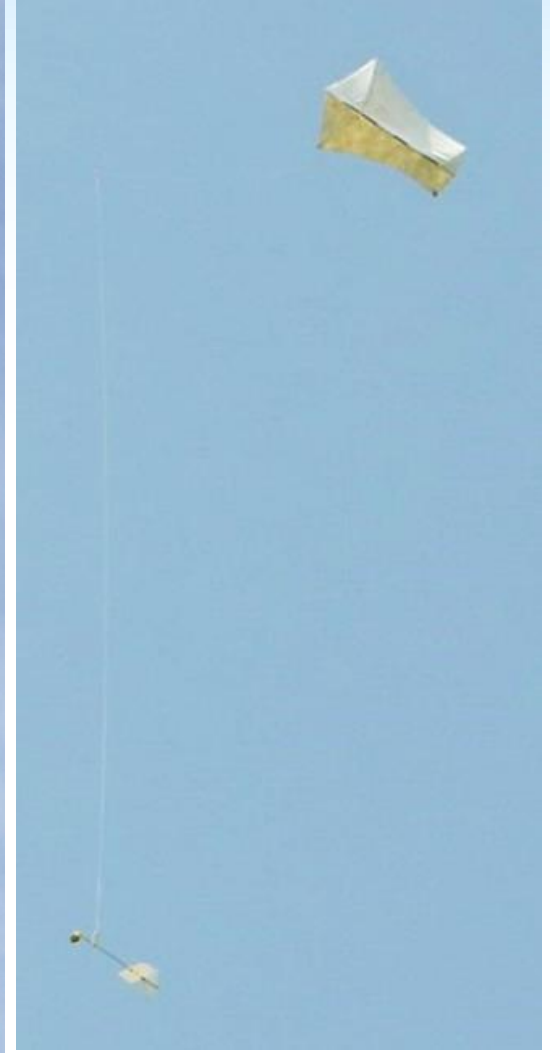


Custom Parafoil



Commercial Delta

<https://intothewind.com/>

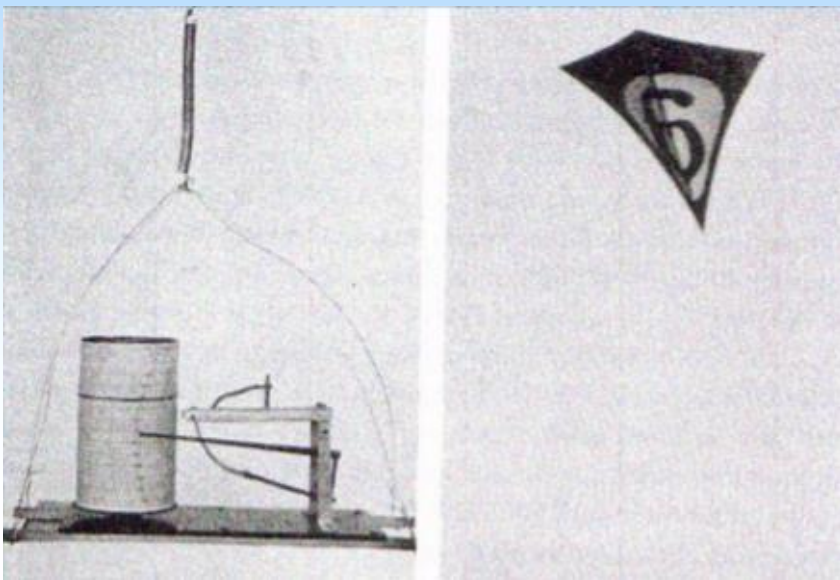


"Tower" Kit

Great Winds Kite Co

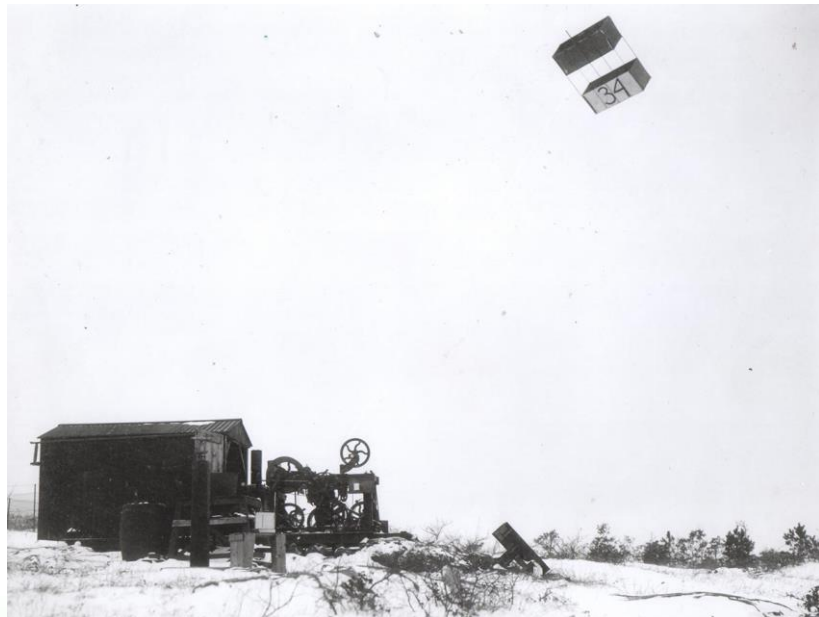
An aerial photograph of a grassy field with many yellow wildflowers. In the foreground, two children are jumping or running towards the camera. In the background, a group of about ten children are standing in a loose circle, watching. The scene is bright and sunny, with shadows cast on the grass.

Thank You!



c.1984

(<https://bluehill.org/about/#!fancybox/71fe9426>)



c.1897

(<https://bluehill.org/about/>)

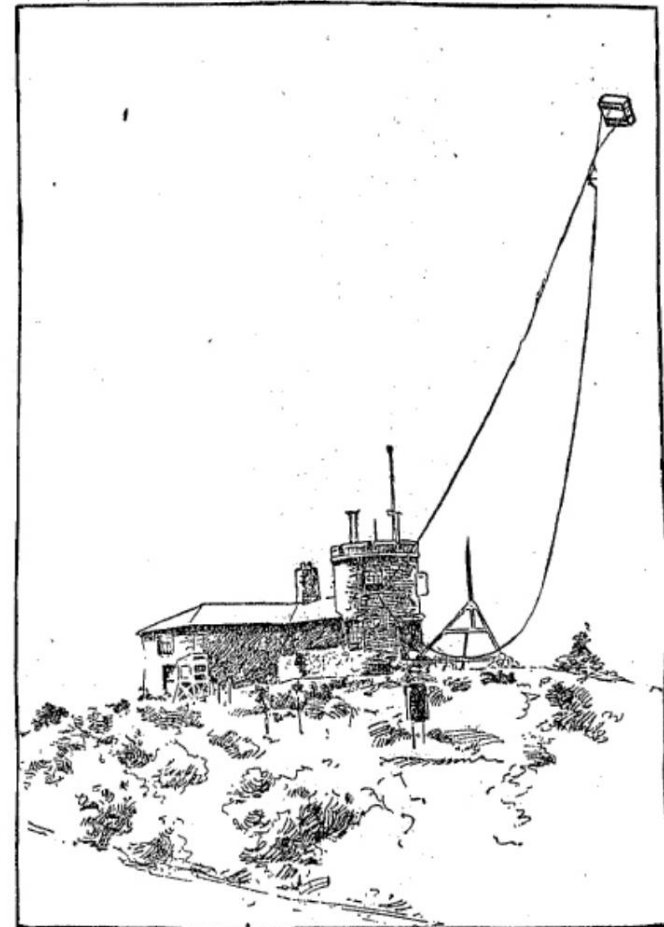
Blue Hill Observatory

<http://best-breezes.squarespace.com/display/ShowJournal?moduleId=323705®isteredAuthorId=46792¤tPage=2>

THE BOSTON SUNDAY GLOBE--AUGUST 13, 1899.

BLUE HILL'S WIRELESS MESSAGES.

Experiments With the New Telegraphy Prove Very Successful at the Meteorological Station, Under the Direction of A. Lawrence Rotch--Marconi Transmitter Has Been Used--Immense Kites Have Been Utilized--Wonders Hoped For.



KITE EXPERIMENTS WITH WIRELESS TELEGRAPHY.